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REMINISCENCES OF RAPHAEL MELDOLA.

Raphael Meldola: Reminiscences of his Worth and Work by Those Who Knew Him, together with a Chronological List of his Publications, MDCCCLXIX–MDCCCCXV. Edited by James Marchant. Pp. xv+225. (London: Williams and Norgate, 1916.) Price 5*s*. net.

ALTHOUGH the late Prof. Meldola's oft-repeated warnings to the nation on the decline of our chemical industries would fully entitle him to a place among the prophets, yet it could not truly be said of him, as was stated of the earlier seers, that he was "not without honour, save in his own country," for in spite of the distractions and anxieties of the present troublous times, more than twenty of his friends and colleagues, men eminent in their respective professions, have already in a few months contributed in his memory their tributes of appreciation and respect. These reminiscences of Meldola's worth and work have now been collected in a convenient volume which includes a chronological list of his original papers and other publications.

The biographical memoir by Sir William Tilden serves to emphasise the many-sided character of Meldola's scientific activities. Not only was he a brilliant chemist of wide experience, with special knowledge of synthetic dyes, but he was also a practical astronomer and a first-rate biologist.

A glimpse of Meldola's early days is furnished by Miss Neumegen, whose father taught him from the age of seven to fourteen years. His first chemical lecture was delivered at the age of fifteen to an audience of schoolfellows, of whom Sir Isidore Spielmann was one. Reminiscences extending over a period of forty years are contributed by Sir Edward Thorpe. Some of the incidents recorded have their humorous side, and testify to Meldola's sense of fun and love of the whimsical. His surpassing merits as professor of chemistry are cordially depicted by his former pupils, Dr. M. O. Forster and Prof. W. J. Pope, and by his colleagues of the Finsbury Technical College, where he presided over the chemical department for thirty years.

Prof. Green deals sympathetically with the classification of his technical and scientific researches. The technical investigations were often of a pioneer character. They opened up new ground, but in many cases the harvest was reaped in other countries. The first oxazine dye, "Meldola's blue," was not introduced into commerce in England, but was manufactured in Germany, where it became the forerunner of the still more important gallocyanine blues. His study of beta-naphthylated rosaniline led to a sulphonic acid which has since acquired importance in cotton dyeing. The researches on azo-dyes, although ignored in England, were utilised profitably by the astute colour-makers of Germany. His scientific chemical work can be classified under eight headings, of which the most important are the studies on azo- and diazoamino-compounds, and on substitution in the naphthalene series. In recent years Meldola and his assistants were engaged in studying imidazole and quinone ammonium bases, these researches being still in progress when death overtook him last November.

Prof. Poulton, who edits the bibliography of published works, contributes also an essay on Meldola as a naturalist. This appreciation contains many interesting reminiscences, some of which are published for the first time. Although Meldola received numerous scientific and academic honours from British sources, it is significant that during his lifetime he was even more appreciated in France. Twice he was offered a decoration of the Legion of Honour, and one learns with amazement that on each occasion the Foreign Office forbade him to accept this distinction!

Where so many distinguished contributors have united in a labour of love to place on record their happy recollections of this great teacher's work and personality, it would be superfluous to add more than that all these praises are worthily bestowed as a last fitting tribute to a life of high ideals and great accomplishment. It may, however, be mentioned that in addition to his published works and the grateful remembrances of his pupils, Meldola leaves behind another memorial in the form of a unique collection of research chemicals. The writer and two other former students of Prof. Meldola have spent a portion of the summer recess in arranging and cataloguing this collection, of which the specimens represent every phase in his career as chemical investigator. The preservation and study of these historical substances will constitute another method of keeping his memory green in the school of chemistry which he inspired and adorned for many years.

G. T. M.

ANIMA ANIMANS.

The Breath of Life. By John Burroughs. Pp. xi+295. (London: Constable and Co., Ltd., 1915.) Price 5*s*. net.

TWO ideas struggle for mastery in the mature reflections of this lover of nature and poetry: the one the super-mechanical and super-chemical character of living creatures, the other the continuity of natural processes and the universality of natural law. Living organisms transcend machinery; they are so persistent, insurgent, constructive, and inventive; but they are not possessed by any extraneous entelechy. They are solidary with the inanimate, though the creative energy or "procreant urge" finds freer expression in them than it does in crystal or star. It is a modernised hylozoism to which the essays composing this volume give beautiful expression: "The psychic arises out of the organic, and the organic arises out of the inorganic, and the inorganic arises out of—what? The relation of each to the other is as

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intimate as that of the soul to the body; we cannot get between them even in thought, but the difference is one of kind and not of degree." There is much in the volume about the wonders of the inorganic domain, especially under the eyes of modern chemists and physicists, but the refrain is always what Tyndall called "the mystery and the miracle of vitality." Thus, to mention half of the fascinating studies, we have discussions of "The Breath of Life," "The Living Wave," "The Baffling Problem," "Scientific Vitalism," and "The Vital Order."

It is not easy to describe the life of the bee-hive without the postulate of psychical organisation, what Maeterlinck called the Spirit of the Hive; so to Burroughs it appears necessary to recognise a more than physico-chemical unity of the organism, in which the cells are the bees, and thus he speaks of the Spirit of the Body. But this vitality is potential in all matter, though it finds opportunity to manifest itself with emphasis in protoplasm. Vitality begins in the inmost sanctuary of the molecules, "but whether as the result of their peculiar and very complex compounding or as the cause of the compounding—how are we ever to know?" The striking essay entitled "A Bird of Passage" develops the idea that life plays a very small part in the total scheme of things, "the great cosmic machine would go on just as well without it." Yet it is only in the highest expressions of life that the total scheme of things acquires any meaning at all. And the author ends with the thought, which he knows to be beyond science, that there is a kind of universal mind pervading not only living matter, but the stuff of which the whole world has been spun. As the reader is warned in the preface, there is considerable reiteration in the course of the essays, but with a writer like Burroughs the impression left is that of music with a recurrent theme.

J. A. T.

DIOPHANTINE ANALYSIS.

Mathematical Monographs. No. 16, *Diophantine Analysis.* By R. D. Carmichael. Pp. vi+118. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 5*s.* 6*d.* net.

THE remarkable thing about Diophantine analysis is that, although it is quite respectably old, it is still in that stage where the amateur is on an equal footing with the professional. If it be true, as we are inclined to think, that Fermat's last theorem admits of a Diophantine proof, this is as likely to be discovered by a schoolboy as by a professor steeped in all the lore of modern analysis.

Prof. Carmichael's book is welcome because it gives, either in the text or in the examples, a great deal of the actual results hitherto obtained; and the author has done something towards sorting out these results and adumbrating a real theory. In this respect chap ii. (on multiplicative domains) is the most valuable. Chap. v. gives a brief but up-to-date account of what is known about Fermat's last theorem. Important sections are those which treat of Fermat's methods of "descent" and of "double equations"; these, at any rate, are definite processes capable of extension to various cases.

The weak point of the book, in our opinion, is that the author never looks at a problem from a geometrical point of view. Of course, in the last resort, geometry is irrelevant; but in research it is very valuable. For instance, let $F(x, y, z)$ be a homogeneous cubic; then from the theory of curves we can conclude that if $F=0$ has an integral solution (x_1, y_1, z_1), it has a sequence (x_n, y_n, z_n) of integral solutions, which in most cases corresponds to a compact set of points on the curve $F=0$. The proof of this is most easily obtained from elliptic functions; there ought to be a purely Diophantine proof, but the difficulty is that we have to estimate the "nearness" of a solution (x', y', z') to a solution (x, y, z), and (x_2, y_2, z_2) in the sequence is not generally "near" to (x_1, y_1, z_1) in the geometrical sense. Again, if we have a unicursal surface, such as that given by the parametric equations,

$$x=\frac{q(\lambda\mu+1)}{\lambda+\mu}, \quad y=\frac{b(\lambda-\mu)}{\lambda+\mu}, \quad z=\frac{c(\lambda\mu-1)}{\lambda+\mu},$$

whence $x^2/a^2+y^2/b^2-z^2/c^2=1$, this suggests corresponding Diophantine theorems. Then, too, we have to consider solutions which, though not integral in the ordinary sense, are integral in certain algebraic fields; for instance, if $2\rho=-1+i\sqrt{3}$, then $(25-6\rho,\ 1-9\rho,\ 8+30\rho)$ is a solution of $x^3+7y^3-z^3=0$, which is integral in the field (ρ), although it is not so in the field (1). In the latter field we have the solution $(1, 1, 2)$; the reader is left to discover whether there are any other ordinary integral solutions, and if so, how many.

There are numerous exercises in the book which ought to stimulate the reader; some of them are practically suggestions for research. As a rule, it is unfair to expect a mathematical writer to give exact references to the sources of his examples; but in this case we wish Prof. Carmichael had been a little more definite, because in this subject even a short note on a very special problem may possibly contain the germ of an important discovery. As an instance of what we mean, Eisenstein's proof of the irreducibility of $(1-x^p)/(1-x)$, when p is prime, is based on a theorem of his which must surely admit of some generalisation. To find whether any given polynomial is irreducible or not is practically such a laborious task (though theoretically possible) that special theorems like Eisenstein's are always welcome.

We hope that this book will have a wide circulation among mathematicians of all ages and capacities; it is rather a disgrace to the moderns that in this field they have added so little to the work of that great triumvirate, Diophantus, Fermat, and Euler.

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